

warnings were displayed on the Atlantic coast southward from New England to Jacksonville, Fla., and on the 6th when a disturbance of increasing intensity was central off Cape Cod, northwest storm warnings were continued at and north of Delaware Breakwater. The evening of the same day and for the same stretch of coast the warnings were changed to southwest, for strong backing winds attending the eastward movement of a disturbance of pronounced character that had its center north of the Great Lakes. This disturbance passed rapidly eastward to the Gulf of St. Lawrence with strong winds and gales along the coast where storm warnings were displayed; and it was followed by rapidly rising pressure and decidedly colder weather along the northeastern border, cold-wave warnings being ordered the morning of the 7th for northeastern New York and northern New England.

On the 10th when a disturbance of pronounced character was central over the Mississippi Valley and advancing eastward, small-craft warnings were displayed over the Mobile and Pensacola storm warning districts, northeast storm warnings on the New England coast and southwest storm warnings along the coast at and between New York City and Savannah, Ga. This disturbance advanced steadily east-northeastward, and storm winds were general during the night of the 10th and during the 11th along the Atlantic coast. The highest velocity reported was 72 miles an hour from the south at New York City and Atlantic City. Relatively tranquil weather prevailed from the 11th until the 15th and 16th, although storm warnings were displayed on the Atlantic coast from Delaware Breakwater to Boston on the 13th when a disturbance of moderate intensity was central off Cape Hatteras. It moved northeastward, its center, however, keeping off the coast, and no winds of gale force occurred over the area where storm signals were displayed. On the 15th, the pressure was abnormally high in the Atlantic States and low in the Mississippi Valley, with a center of minimum pressure over Louisiana. The system of low pressure was advancing northeastward and the Louisiana disturbance increasing in intensity. Therefore, in the early morning small-craft warnings were displayed on the east Gulf coast and later in the day southeast storm warnings were displayed on the Atlantic coast at and between Jacksonville, Fla., and the Virginia Capes. On the morning of the 16th when the center of the disturbance was over Indiana, southeast storm warnings were displayed on the Atlantic coast north of the Virginia Capes and cold-wave warnings were ordered for Tennessee, the Ohio Valley, and the lower Lake region. This disturbance is the one referred to in the opening paragraph as being the most intense of the month on the Atlantic coast. The highest wind velocity reported was 76 miles an hour at Atlantic City, N. J.

On the 19th and 20th the pressure rose abnormally over the northwest following the eastward movement of a belt of low pressure which extended southward from the northern border to the Gulf of Mexico, and as the change to colder therewith was pronounced, it was necessary on the 19th and 20th to issue cold-wave warnings for practically all parts of the Washington Forecast District and northwest storm warnings on the morning of the 20th for the Atlantic and Gulf coasts. It was also necessary on the 22d to issue southwest storm warnings for the Atlantic coast north of Delaware Breakwater and to continue these storm warnings on the 23d, on which date cold-wave warnings were also displayed over northeastern New York and northern New

England. On the 24th, when the barometric pressure was quite high in the Atlantic States, low over the lower Mississippi Valley and high and rising rapidly in the northwest, southeast storm warnings were displayed on the east Gulf and Atlantic coasts and cold-wave warnings were displayed in western Tennessee and Kentucky. On the 25th cold-wave warnings were displayed over practically the entire Washington Forecast District and storm warnings were continued on the Atlantic coast at and north of Cape Hatteras. The severity of this storm was such as to require that storm warnings be continued on the 26th at and north of Delaware Breakwater.

#### CHICAGO FORECAST DISTRICT.

In the Chicago forecast district, January, 1924, was a rather notable month. Over the Missouri and middle and upper Mississippi valleys, as well as in the extreme western upper Lake region, it was, generally speaking, the coldest January since the memorable month of that name in 1918. Sudden and marked alternations in temperature were a feature of the month, and over at least a limited area (Chicago and its vicinity) the mean daily variability of temperature exceeded all previous records of this character. As might be inferred from the foregoing, cold waves were of frequent occurrence, and in one or two instances these were of great severity in portions of the district.

*Cold wave warnings.*—In this section of the REVIEW for December, 1923, reference was made to the culmination, in the first week of the month now under discussion, of the cold wave that affected the district during the closing days of December, and which finally resulted in the lowest temperatures in a decade or more at many points. The conditions during the few days preceding January 5 (when the crest of the cold was reached) were as follows: On the 1st and 2d a pronounced katalobar, with an attendant marked rise in temperature from the prevailing zero values, moved rapidly east-northeastward from the southern Rocky Mountain Plateau to the lower Lake region. This was closely followed by an analobar of similar character, with the result that a decided fall in temperature occurred on the night of the 2-3d throughout the upper Mississippi and the middle and lower Missouri Valleys, the fall reaching the proportions of a cold wave over a large part of the area named. Cold-wave warnings were issued on the night of the 2d for northeastern Michigan, and these were verified. Twelve hours later the warnings were extended to include eastern Lower Michigan and eastern and southern Indiana. While a considerable fall in temperature occurred over these areas, a technical verification was not attained. In the meantime a high pressure area with attendant very low temperatures had been developing over British Columbia, and at the same time increasing in magnitude. By the morning of the 3d the barometer at Kamloops was 30.68 inches and the temperature  $-10^{\circ}$ , while an area of falling barometer was over the middle Rocky Mountain Plateau. Twelve hours later this latter area was forced to western Texas, and by the morning of the 4th to extreme southern Texas, whence it moved rapidly northeastward, in deepened form, to the upper Ohio Valley on the night of the 4th. During the passage of this katalobar a portion of the British Columbia high area moved to the upper Missouri Valley, the barometer at the same time continuing to rise, so that readings were 31 inches or somewhat above over a considerable area on the 4th. By the early night of that date severe

cold prevailed southward over Iowa, the temperature at Des Moines at 7 p. m. being 12° below zero. During the succeeding 12 hours the cold wave swept south-eastward to the Ohio River with resulting temperatures (as previously mentioned), the lowest in more than a decade at many points. At Chicago, Ill., the minimum of -16° equaled the low record made on January 7, 1912. The reaction from this cold wave was very marked, and over some areas, particularly in the northern Plains States, the 24-hour rises amounted to from 50° to 60°.

The next cold wave appeared on the 9th in Saskatchewan and Manitoba, coming apparently from the region east of Alaska. At the same time a well-developed disturbance was central near the Kansas-Colorado boundary. Accordingly, warnings for a moderate cold wave were issued for most of the upper and middle Mississippi Valley, the Central Plains and Wyoming. Although a considerable fall in temperature occurred over the areas in question, verification was not attained except over a limited area.

On the night of the 14th a new cold wave appeared over the Canadian Northwest. During the following 24 hours the cold overspread the district as far as the upper Mississippi and middle Missouri Valleys, and the remainder of the district by the morning of the 17th, zero weather prevailing southward as far as St. Louis, Mo. The warnings issued in connection with this cold wave were fully verified.

In rapid succession to the cold wave just referred to, conditions again became critical over portions of the Northwest, so that warnings were issued on the night of the 17th for western Nebraska, northwest Montana, and Wyoming. These were verified, but the extension of the warnings on the morning of the 18th over Minnesota and northwestern Iowa was not justified.

On the morning of the 19th the temperature in southern Missouri, southern Illinois, and Indiana was comparatively high, in connection with a trough of low pressure that overlay those areas. At the same time a marked high area with attendant low temperatures was present in the Northwest—conditions apparently favorable for a cold wave in the areas named. Accordingly, warnings were issued, and the cold wave occurred as forecast.

By the morning of the 22d the barometer was rising rapidly throughout the Canadian Northwest, and based largely upon this condition cold wave warnings were issued for most of the northern States of the district. Subsequent developments, however, were such that the cold waves that occurred were confined to northeastern Montana, North Dakota and Minnesota.

The final cold wave of the month began on the 24th, and it swept the entire district during the following two days. In most cases the general warnings that were issued were verified. Over a considerable area the 24-hour fall in temperature ranged from 35° to 40°.

The reaction from this last cold wave continued during the remainder of the month with the result that the mildness of the closing days had a marked effect on the final average temperature of the month, increasing it by several degrees. Otherwise the month would have been more nearly comparable with the cold January of 1918.

*Warnings for Lake Michigan.*—Stormy weather prevailed on Lake Michigan on several occasions during the month, and with one or two exceptions timely advices of impending conditions were issued. The first strong winds to occur were in connection with the reaction from the severe cold wave of the 5th. A low-pressure area moved southeastward from the Canadian Northwest on the 5th

and 6th, which, in connection with the great cold high area that overlay the South on the 6th, created a sharp gradient over Lake Michigan, with the result that strong winds and moderate gales occurred on that date. The advisory warning in this connection was issued on the morning of the 6th.

The next advisory for Lake Michigan was that on the 9th in connection with the storm that crossed the Great Lakes on the 10th. At some points on Lake Michigan moderate gales occurred. The advisory warning was continued on the 10th.

On the 16th a warning was issued in connection with the disturbance that preceded the cold wave of the 17th. The storm center passed eastward just south of Lake Michigan, and although the gradient was rather steep, no storm winds were reported from points on the Lake.

So far as pressure conditions were concerned, the reaction from the severe cold wave of the 21st-22d was quite similar to that which occurred on the 6th. Advisory warnings were issued on both the 21st and 22d, and strong southwest winds and moderate gales were general on Lake Michigan on those dates.

The last advisory warning for Lake Michigan was issued on the night of the 24th in connection with the cold wave that was about to overspread the Lake. At that time an elongated disturbance was advancing eastward across the Lake region with increasing strength. By the morning of the 25th the disturbance had become a storm of the first magnitude with its center over Georgian Bay, and a barometer reading of 29.24 inches at Parry Sound. At the same time the pressure was about 30.60 inches over the upper Missouri Valley. Press dispatches indicate that the 25th was one of the stormiest days in years in lower Michigan.

Stock interests were advised on the 9th, 15th, 22d, and 24th of expected weather conditions that might prove adverse.—*C. A. Donnel.*

#### NEW ORLEANS FORECAST DISTRICT.

Unseasonably cold weather prevailed throughout the district, with some intense cold waves. The first cold wave of the month occurred at El Paso, Tex., on the 3d, for which warning was issued on the 2d. Cold-wave warnings were issued on the evening of the 3d for Oklahoma, the northern portion of west Texas, and the northwest portion of east Texas, and extended on the morning of the 4th over Arkansas. Conditions were such on the 4th that special observations were called for and these showed a rapid movement of the high pressure and cold wave towards the south, and livestock, cold-wave and freezing-temperature warnings were extended to the West Gulf coast. The cold wave came with unusual rapidity, and in parts of the district was the coldest during the last five years. Much saving of property resulted from the warnings.

Another severe cold wave overspread the interior of the district on the 10th, for which warnings had been issued on the 9th. Warnings were issued on the 16th for a moderate cold wave which occurred over the northern portion of the district on the 17th. Warnings were issued on the 19th for a severe cold wave which overspread the greater portion of the district on the 20th and 21st, with temperature below freezing to the Gulf coast. No cold wave of any consequence occurred without warning. Storm warnings were displayed on parts of the Texas coast on the 4th, 19th, and 20th, all of which were verified. Storm warnings on the Louisiana coast were only partially verified but conditions were so